REMARKS

Introduction

Claims 1, 3-5, 6, and 9-21 are pending in this application, with claim 1 being independent. Claim 1 has been amended to incorporate the subject matter of claims 2, 7 and 8 to more clearly define the claimed subject matter. Accordingly, claims 2, 7 and 8 have been cancelled without prejudice. Care has been exercised not to introduce new matter. For the reasons set forth below, Applicants respectfully submit that all pending claims are patentable over the cited prior art.

Double Patenting Rejection

Claims 1, 4-5, 7-8, 12, 16-17, and 19-21 were provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 3, 4-10 of copending Application No. 11/402,062. Claims 1-21 were rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-14 of US Patent No. 7,481,879.

Applicants respectfully submit that a terminal disclaimer is being concurrently filed herewith. Accordingly, it is requested that the Examiner withdraw the rejections of claims 1-21 on the ground of nonstatutory obviousness-type double patenting.

Claim Rejection under 35 U.S.C. § 102/103

Claims 1-3 were rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being unpatentable over Meguro et al. (Japanese Pub. No. 2003-277183). Applicants respectfully traverse these rejections for at least the following reasons.

The present subject matter is, as recited by amended claim 1, directed to a single crystal diamond grown by vapor phase synthesis, wherein when one main surface is irradiated with a linearly polarized light considered to be the synthesis of two mutually perpendicular linearly polarized light beams, the phase difference between the two mutually perpendicular linearly polarized light beams exiting another main surface on the opposite side is, at a maximum, not more than 50 nm per 100 μm of crystal thickness over the entire crystal. The claimed single crystal diamond has a thickness of at least 200 μm and not more than 1500 μm, and a half-width between 10 and 80 seconds in an X-ray rocking curve in a (400) plane over an entire crystal. Further, the claimed single crystal diamond contains hydrogen and nitrogen as impurities with a concentration of hydrogen atoms between 20 and 70 ppm and a concentration of nitrogen atoms between 0.01 and 100 ppm.

The claimed single crystal diamond of the present disclosure is suitable as an electronic device substrate or an optical component material because of its characteristics which are favorable in optical applications and semiconductor device applications, and thus the present subject matter is also directed to a semiconductor substrate (see, claim 20) and an optical window (see, claim 21), both comprising the above single crystal diamond.

As set forth in paragraph [0031] of the present specification, the phase difference as recited by claim 1 was obtained based on Applicants' finding that keeping the phase difference produced when mutually perpendicular linearly polarized light beams pass through a single crystal diamond within a certain range in an evaluation method utilizing birefringent light is important in terms of maintaining good characteristics as a semiconductor device substrate and good characteristics as an optical component.

The claimed single crystal diamond is, as described in paragraph [0030] of the present specification, obtained by a manufacturing method comprising 1) a step of providing a single crystal diamond substrate produced by vapor phase synthesis as a seed substrate, and 2) a step of etching away one main surface of the single crystal diamond substrate as the seed substrate by reactive ion etching (hereinafter referred to as RIE) and then growing a new single crystal diamond layer on the main surface of the seed substrate by vapor phase synthesis. Preferably the single crystal diamond substrate used as the seed substrate is separated from the single crystal diamond layer newly grown by vapor phase synthesis. Furthermore, the side surfaces of the single crystal diamond seed substrate can also be etched away by RIE prior to the step of etching away the main surface of the seed substrate, whereby more desirable characteristics can be ensured in the grown single crystal diamond. The results of the examples demonstrate that the single crystal diamonds grown by vapor phase synthesis on the seed substrate, which is prepared by vapor phase synthesis and is subjected to RIE, according to the present disclosure have the intended desirable characteristics.

Turning to the cited reference, Meguro appears to disclose a method for producing a single crystal diamond comprising a step of providing a single crystal diamond substrate 101 as a plate-like seed crystal having a thickness of ≤100 μm and a step for growing a single crystal diamond 102 on the single crystal diamond seed substrate 101 by a vapor phase synthetic method (see, the abstract and claim 1 of Meguro). The single crystal diamond seed substrate 101 is prepared by providing a single crystal diamond seed substrate 101 having a thickness of >100 μm and reducing the thickness of the single crystal diamond substrate 101 to ≤100 μm by removing a part of the single crystal diamond seed substrate 101 by RIE. In this regard, paragraphs [0017], [0029] and [0030] of Meguro state as follows:

> [0017] In the manufacturing method of the single crystal diamond substrate of this invention, preferably, a single crystal diamond substrate having a thickness of no less than 100 μm is etched away by reactive ion etching so that the thickness is reduced to 100 μm or less. ...
>
> [0029] Also, the preparation process for the single crystal diamond substrate preferably comprises a step of readying a single crystal diamond substrate with a thickness of greater than 100μm and a step of reducing the thickness of the diamond crystal substrate by removing a part of the substrate to 100 μm or less.
>
> [0030] The step of removing a part of singly diamond crystal substrate preferably includes a step of removing a part of single crystal diamond substrate by reactive ion etching.

The method of Meguro was proposed on the finding as described in paragraph [0009] of Meguro as follows:

> [0009] It was found that when a plate-like seed crystal with a thickness of no more than 100μm, the seed substrate has relatively light influence on a single crystal diamond grown thereon and phenomena, such as deformation of the single crystal diamond, exfoliation, or a crack, can be minimized. This plate-like single crystal may be various single crystal materials including diamond. The single crystal may be an arbitrary single crystal film which is formed on a monocrystalline or polycrystalline crystal and permits heteroepitaxial growth of diamond thereon. For example, the plate-like single crystal may be single crystal Pt formed on polycrystalline Si or single crystal diamond directly grown up on an arbitrary polycrystalline material. The smaller the thickness of the seed crystal, the better as far as the thickness is no more than 100μm.

As such, it is clear that the most important feature of the production method of Meguro is the use of a single crystal diamond seed substrate having a thickness of ≤100 μm and therefore the thickness of the seed substrate has to be reduced to ≤100 μm prior to growing single crystal diamond thereon if the thickness of the seed substrate is over 100 μm. Further, it is clear that Meguro fails to disclose the use of the etching of the side surfaces of the seed substrate.

Meguro also fails to disclose the use of, as a means for evaluation of the grown single crystal diamond, the phase difference produced when mutually perpendicular linearly polarized light beams pass through the diamond. Meguro fails to disclose or even suggest that the phase difference of the mutually perpendicular linearly polarized light beams which have transmitted

through the diamond can be effectively used for evaluation of the characteristics of grown single crystal diamond.

In this regard, in order to remedy the deficiencies of Meguro et al, the Examiner compares the manufacturing method of single crystal diamond of Meguro with the manufacturing method disclosed in this application. The Examiner states that "since the method for manufacturing as recited by Meguro et al. is not patentably distinguishable from the method recited by applicant in the Specification, Examiner takes the position that the diamond taught by Meguro et al. will inherently or obviously have the same properties." Applicants, however, respectfully disagree.

When the method disclosed in Meguro is compared with the method for producing the claimed single crystal diamond, there are the following differences between them:

1) In Meguro, the thickness of the seed substrate prior to growing diamond on the seed substrate has to be ≤100 μm as discussed above. In contrast, as disclosed in the examples of the present application, Samples B-D of the present invention are grown on single crystal diamond seed substrates which are respectively prepared by etching away the main surfaces of Samples A, A' and A" by 16 μm, 22 μm and 16 μm. Since Samples A' and A" as the seed substrates are prepared at the same time as Sample A, these seed substrates A' and A" have the same thicknesses as A before RIE. The thickness of Sample A before RIE is 0.2 mm, i.e., 200μm (see, paragraph [0048] and Table 1 of the present specification). Therefore, the seed substrates after RIE used for Samples B-D have a thickness exceeding the upper limit of 100 μm for the seed substrate of Meguro after RIE, and such thick seed substrates cannot be used in the method of Meguro.

2) Meguro states that single crystal diamond can be grown up to 100 μm in thickness without abnormal growth onto the seed substrate having a thickness of ≤100 μm (see paragraphs [0065], and [0092]) and no examples of growing single crystal diamond exceeding 100 μm are shown. In contrast, the claimed single crystal diamond grown by vapor phase synthesis has a thickness of no less than 200μm as stated in claim 1. As shown in Table 1 of the present specification, the claimed single crystal diamond having a thickness of no less than 200 μm can be obtained without any problem.

Therefore, it is clear that the claimed single crystal diamond is obtained by a different manufacturing method from the manufacturing method as disclosed in Meguro, and thus the Examiner's position that "the diamond taught by Meguro et al. will inherently or obviously have the same properties" has no merit. Applicants respectfully submit that there is no basis for the Examiner's assertion that the diamond taught by Meguro has the same properties in the phase difference measured by using the polarized light beams as recited by claim 1. In addition, the claimed single crystal diamond has a half-width between 10 and 80 seconds in an X-ray rocking curve in a (400) plane over an entire crystal, and has, as impurities, a concentration of hydrogen atoms between 20 and 70 ppm and a concentration of nitrogen atoms between 0.01 and 100 ppm. The single crystal diamonds disclosed in Meguro do not have these properties as recited by claim 1 at the same time. Further, in the examples of Meguro, single crystal diamond, produced by <u>high-temperature, high-pressure synthesis</u> and etched to their thicknesses to no more than 100μm by RIE, are mainly used as a seed substrate (Examples 1-3 and 5), while single crystal <u>silicon</u> is used as a seed substrate (Example 4) and single crystal diamond produced by vapor phase synthesis is used as a seed substrate in Example 5 at [0091]. In contrast, Samples B-D of the present disclosure use single crystal diamond seed substrates produced by vapor phase synthesis

having more than 100μm in thickness and show superior properties over other samples using seed substrates of natural diamond crystals and synthetic high-temperature and high pressure diamond crystals (see, Table 1 of the present specification). In Meguro, there is no disclosure or suggestion of the advantage of a seed substrate produced by vapor phase synthesis over natural diamond crystals and synthetic high pressure diamond crystals.

Based on the foregoing, Applicants respectfully submit that Meguro fails to disclose the single crystal diamond as recited by claim 1. Accordingly, claim 1 and all claims dependent thereon are patentable over Meguro. Thus, it is requested that the Examiner withdraw the rejections of claims 1 and3 under 35 U.S.C. § 102(b)/103(a).

<u>**Claim Rejection-35 U.S.C. § 103**</u>

Claims 1-21 are rejected under 35 U.S.C.103(a) as being unpatentable over Linares et al. (US Pub. No. 2003/0131787) in view of Meguro et al. This rejection is traversed for at least the following reasons.

Linares appears to disclose single crystal diamond obtained by chemical vapor deposition (CVD) and application of this diamond to semiconductor devices, optical waveguides, etc. As conceded by the Examiner, Linares does not teach treating the surface of the diamond substrate with using RIE. The Examiner then relies on Meguro attempting to remedy the deficiencies of Linares stating that "since Linares et al. in view of Meguro et al. teaches a diamond made by the same method as taught by applicant, a vapor phase synthesis diamond on a vapor phase synthesis diamond substrate in which the substrate has been treated with RIE, Examiner takes the position that the product created by Linares' method will exhibit the properties claimed by applicant such

as the phase difference exhibited between two mutually linearly perpendicular polarized light irradiated on a surface of the crystal."

Applicants respectfully submit that the Examiner attempts to combine Meguro with Linares based on a misunderstanding of Meguro. Applicants incorporate herein the arguments previously advanced in traversal of the rejection under 35 U.S.C. § 102(b)/103(a) predicated upon Meguro. As set forth above, the method of Meguro is different from the method disclosed in the present disclosure.

Further, the seed substrate used in the manufacturing method of Linares may be chosen from among natural diamond crystals, synthetic high pressure diamond crystals or synthetic CVD diamond crystals (see, paragraph [0115] of Linares) similar to Meguro. Thus, there is no suggestion of the advantage of a seed substrate produced by vapor phase synthesis over natural diamond crystals and synthetic high pressure diamond crystals. Therefore, it is clear that the claimed single crystal diamond grown by vapor phase synthesis is obtained by a different manufacturing method from the manufacturing method disclosed in Linares or Meguro, and thus there is no basis for the Examiner's assertion that the product created by Linares' method would exhibit the properties as recited by claim 1 in which the phase difference is produced when mutually perpendicular linearly polarized light beams pass through the diamond. This is further evidenced by Examples in the present disclosure. As mentioned above, Samples B-D of the present disclosure exhibit superior properties over those of comparative samples. More specifically, as discussed in paragraphs [0057] to [0060] of the present specification, comparative samples A and E using a seed substrate <u>without RIE</u> have phase difference outside the range specified by claim 1, and their properties are far inferior in comparison with those of Samples B-D. Further, Samples F-I (natural diamonds) and Sample J-M (diamond made by

high-temperature, high-pressure synthesis) are comparative examples because they are not diamonds produced by grown by vapor phase synthesis. It is clear that these comparative samples are also inferior to Samples B-D.

Based on the foregoing, Applicants respectfully submit that Linares as combined with Meguro fails to disclose or suggest the claimed single crystal diamond specified by the phase difference produced when mutually perpendicular linearly polarized light beams pass through the diamond. Accordingly, claim 1 and all claims dependent thereon are patentable over the cited references. Thus, it is requested that the Examiner withdraw the rejections of claims 1, 3-5, 6 and 9-20 under 35 U.S.C. § 102(b)/103(a).

CONCLUSION

Having fully responded to all matters raised in the Office Action, Applicants submit that all claims are in condition for allowance, an indication for which is respectfully solicited. If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, the Examiner is requested to call Applicants' attorney at the telephone number shown below.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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